UNIQUE DESIGN ASPECTS OF SMALL SPACECRAFT FOR LOW COST PLANETARY MISSIONS**

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ABSTRACT

The NASA emphasis for "faster, cheaper, better" missions for solar system exploration poses a unique challenge to small satellite builders who have more experience to date with small spacecraft for Earth orbiting missions. This objective of this paper is to describe the unique design aspects of small interplanetary spacecraft for the benefit of those who do not have the experience. The paper will start by illustrating a range of missions with varying scientific objectives — for inner planets, outer planets, small bodies, and space physics — and then address the added spacecraft capabilities or modifications compared to Earth-orbiter designs which will make each mission possible.

Small spacecraft, in addition to being less expensive yet still capable , may be able to bring a new dimension to solar system exploration, One small spacecraft can be launched together with a larger spacecraft and then used to enhance the science return. It may be used, for example, to carry instruments into regions which are too hazardous for **more expensive, larger spacecraft, and may be expendable, Or, several small spacecraft may be launched by** a single vehicle, with each sent on a separate mission, or all sent to be used in unison, for surface mapping or atmospheric and fields measurements, for example.

A representative set of mission types to be considered in this paper is the following: 1) Multiple Spacecraft Near Earth Asteroid Flybys, 2) Comet Rendezvous/Penetrator, 3) Main Belt Asteroid Rendezvous, 4) Mercury Polar Flyby, 5) 10 Mapper, 6) General Relativity Laser Experiment, 7) Pluto Fast Flyby and 8) Solar Pioneer.

This paper will describe the unique aspects of these types of missions that drive the spacecraft design process. Some **issues such as** Earth and Sun range are obvious, but these and other considerations also have a large impact on most other spacecraft subsystems such as propulsion, telecomm, power, thermal and data processing. Mission issues such a lifetime and interplanetary navigation also affect the spacecraft design. The interplanetary environment (neutral, plasma, radiation and micrometeroid) is also different than the near-Earth environment in important areas. Finally, the interplanetary launch windows (sometimes as small as 2 weeks every 2 years) drive the spacecraft design and test process in ways different than for many Earth-orbiting spacecraft.

Because of the national and, therefore, NASA's financial crisis, small spacecraft will play an increasingly important role in solar system exploration. In addition, the builders of these spacecraft will, for the most part, not be JPL. This paper attempts to provide information on the unique design aspects of small spacecraft for interplanetary missions in order to benefit those with little or no experinece with this type of spacecraft, Hopefully this process will enhance the probability of success and reduce the risk to NASA for these types of missions.

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